

Practically the only record of loss due to hailstorms is that kept by the hail-insurance companies in their efforts to fix equitable rates for the different counties, and of these the records of but one company cover the State sufficiently and extend over a long enough period of time to give a reliable index of the probability of the occurrence of hail. This company has written almost as much hail insurance in Kansas as all other companies combined, its records showing that it has insured an average of approximately 3½ per cent of the total wheat crop of the State for the past 14 years. A study of its losses, which have been carefully compiled, should give an important clue to the distribution of the loss over the State from year to year.

The average annual loss by hail to the wheat crop in the principal wheat-growing counties of Kansas, expressed as a percentage, is shown in convenient summary in figure 1. The percentages there printed were obtained as follows: The total wheat acreage for each county was taken from the reports of the Kansas State Board of Agriculture. The total acreage insured in each county by the insurance company before mentioned, and the total loss sustained each year in each county by that company, were obtained from the latter. From these figures it was simple to compute the percentage of the total risk lost each year during the period of 18 years, 1899 to 1916, inclusive. Strictly speaking, the figures on the chart, figure 1, are the percentages of loss sustained by the *insured* crop, but it seems safe to assume that, without reasonable error, hail damage was uniform throughout the county, and therefore we present the figures as representing the best obtainable evidence of the damage due to hail in each county. Data for the less important wheat-raising counties have been omitted since the business done by the company there has hardly been sufficient to give a reliable average.

It is interesting to note that the percentage of damage in the extreme eastern counties for which data are available, is considerably less than that of the western. In fact the rate charged by this company for the western counties, as deduced from its tables of loss, is two and a half times that charged for the eastern, and the records of the company show it has lost money on its business done in the western counties while the business done in the eastern counties at the lower rate has paid good dividends.

Figure 2 shows all losses of \$10,000 or more sustained by this company on account of individual storms, and serves to explain the abnormally heavy percentage of loss shown in figure 1 for a few counties such as Norton and Pawnee. The fact that most of these heavy individual losses have occurred in the central counties instead of the western, where the average for the entire period is highest, may be due partly to the heavier stands of wheat in the central portion of the State and partly to more frequent and less violent hail storms in the western portion. There are very few data, however, to support the latter contention.

Hail is so commonly associated with thunderstorms and thunderstorms with heavy rainfall, that it is somewhat difficult to understand why the probability of damage by hail increases toward the western portion of Kansas when both the average annual rainfall, and the rainfall for the crop-growing months in the western third of the State are less than half the averages for those periods in the eastern third. This anomaly is emphasized by Table 1.

TABLE 1.—Losses sustained by hail insurance company in Kansas compared with departures of the July–August rainfall, 1899 to 1916, inclusive, for the State.

Year.	Percentage of loss sustained by hail insurance company.	Departure from normal of total rainfall for July and August.
	<i>Per cent.</i>	<i>Inches.</i>
1899	1	+0.55
1900	2	–1.06
1901	2	–2.27
1902	3	+2.44
1903	4	+1.59
1904	7	+2.99
1905	9	+2.99
1906	2	+1.86
1907	5	+0.27
1908	6	+0.70
1909	5	+0.34
1910	1	–0.21
1911	4	–0.99
1912	2	–0.01
1913	3	–4.94
1914	1	–0.77
1915	9	+3.90
1916	5	–1.96

While this table indicates that the damage by hail is not always proportional to the amount of rain that falls during the harvest months, July and August, the losses of dry seasons such as occurred in 1901, 1910, and 1913, have been small, while those of the notably wet harvest seasons 1904 and 1915 have been heavy; in fact, the season of 1915 brought failure to more hail insurance companies doing business in Kansas than any other year in the history of the State.

What causes this increase in liability of damage by hailstorms in the drier western counties of Kansas? This is an interesting problem that is worthy of future investigation.

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SCARF CLOUDS.

By CHARLES F. BROOKS, Ph. D.

[Office of Farm Management, Washington, July 25, 1917.]

(These notes were written immediately after the observations were made, and before having read anything on the phenomena. Therefore, my observations only substantiate the conclusions reached by previous writers mentioned in the footnotes.)—C. F. B.

The name "scarf cloud" has been applied in conversation, by Prof. W. J. Humphreys to a cloud which forms immediately over a rapidly rising cumulus dome and through which the rising cloud passes without hesitation.

On July 13, 1917, at Washington, D. C., the light easterly wind, clear air, and moderate humidity favored the growth of towering cumuli. By noon some had attained their limiting height, and were sending false cirrus sheets eastward. At about 4 p. m. some showers of very large drops bore witness to the rapidity of the ascending currents through which they fell. By 6 p. m. the air stratum where the cumulus clouds had been spreading their tops was well supplied with moisture, a fact which was marked by the scattered dissolving cirrus cirro-stratus, and cirro-cumulus clouds at this level.¹ At 6:22 a towering ebullient cloud in the north was seen to be surmounted by a thin "disk-cloud";² at 6:23 the

¹ Compare W. J. Humphreys in Bull., Mount Weather obs'y, Washington, 1909, 2:133–135. The "cirro-stratus" of the International cloud atlas, 1896, Pl. xii, fig. 23.

² This "disk cloud" is clearly the same as the usual "cap cloud" or "cumulus cap" whose origin was explained by C. Abbe in this REVIEW, October, 1906, 34:457, and yet earlier described and explained, among others, by Groneman in Meteorol. Ztschr., April, 1901, 18:176–177; Luke Howard, Essay etc., p. 5 & 10.—EDITOR.

JULY 13, 1917.

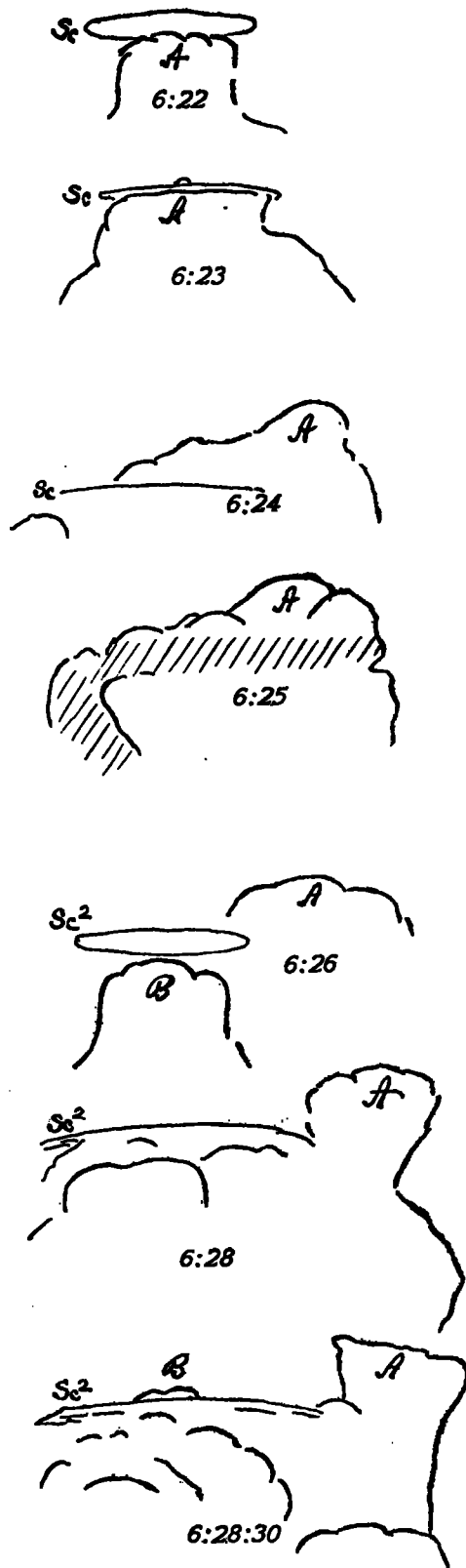


FIG. 1.—Successive stages in development of cumulus with "scarf clouds," July 13, 1917.

JULY 13, 1917.

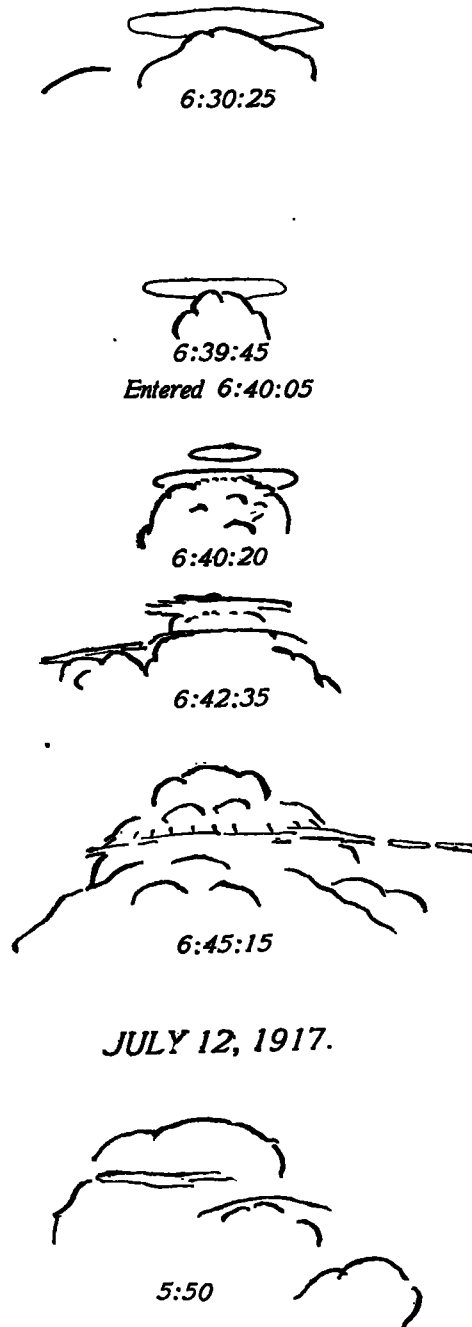


FIG. 2.—Successive stages in development of cumulus with "scarf clouds," July 13, 1917.

JULY 18, 1917.

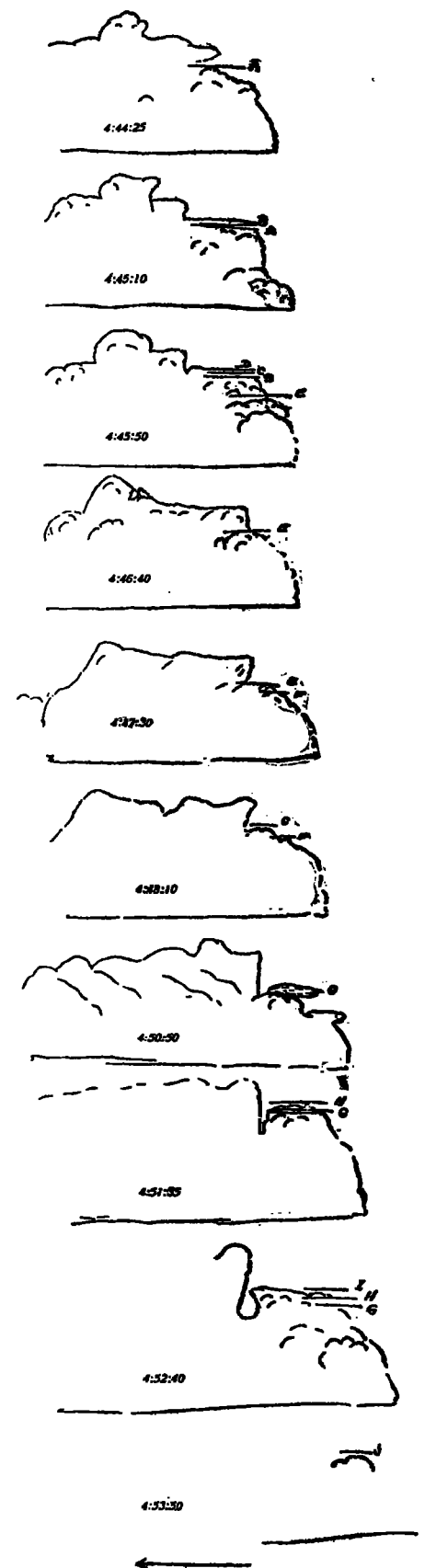


FIG. 3.—Successive stages in development of cumulus with "scarf clouds," July 18, 1917. (Arrow shows drift of cumuli.)

cumulus head appeared above the scarf, and at 6:24 but little of the scarf remained (Fig. 1). At this level was a band of shadow marking the level of the false cirrus clouds not far west. The sun being near the horizon, this shadow was like a narrow girdle round the cloud. At about 6:26 another cumulus head beside the large one made a scarf cloud, and at 6:28:30 it appeared above the top of the scarf. Another hump of the same cloud mass grew rapidly upward from the shadowy lower levels. I watched the air above the tip. At 6:30:25 the scarf cloud suddenly appeared above the rising column (Fig. 2); 30 seconds later the cumulus entered it, and in 55 seconds more it appeared over the top. At 6:32:40 the scarf was entirely gone. Sometime between 6:39:15 and 45 a scarf appeared over another cloud head; at 6:40:5 the cumulus entered the scarf. At 6:40:20 a second scarf cloud appeared above the first. Then at 6:41:30 the cumulus overtopped the first scarf, and at 6:42:35 the second. At the same time a secondary head rising toward the humid layer caused a fine three-leaved scarf cloud to form. By 6:43 the scarf clouds had disappeared. A minute later a thin sheet of cirro-cumulus was seen approaching the thunderhead; at 6:45:15 it reached the rising cloud and was there thickened into scarf formation. A scarf cloud was seen also on July 12, at 5:5 p. m., and another on July 14, at 6 p. m., on the rear side of a great cumulo-nimbus.

On July 18, from a train window between Trenton and New Brunswick, N. J., I observed in the southeast a series of ten scarf clouds between 4:44 and 4:54 on the rear of one cumulus cloud. The surface wind was a moderate breeze from the southwest; at the level of the base of the cumulus the movement was at about 40 kilometers per hour; while at the middle level, the movement was near 55 kilometers per hour, from the southwest. These velocity observations were taken on an accelerating train by noting the speed at which the clouds stopped their apparent forward motion and began to go backward. The train was running parallel to the cloud movement. The sheet of cirro-cumulus, alto-cumulus, and alto-stratus some distance above, was moving at a rate of less than 80 kilometers an hour toward the northeast. Above this false cirrus (?) sheet were some cirrus clouds with scarcely any perceptible forward motion. The level of maximum velocity within the cumulus layer seems to have been at about the middle of the cloud; and it was at this level that the scarf clouds formed. Above this height the top of the cloud seemed to have a dissolving tendency, and to move backward relative to the middle. Still higher, another stronger current from the west marked the top of the cloud; its presence was indicated by the apparent eastward lean of some projecting portions of the cloud. The total vertical thickness of the large cumulus probably did not exceed 2 or 3 kilometers. The ten sketches (Fig. 3) show how the scarf clouds formed successively as cumulus growths added themselves to the rear of the cloud. At 5:05 a small scarf cloud was seen just over one of the highest of the cumulus domes.

Conclusions.

These observations lead to three conclusions:

1. One reason why the scarf cloud is infrequently observed is the rapidity of its formation and disappearance. The total duration of each of the six scarf clouds observed July 13, between 6:22 and 6:43, was from two to three minutes only, and those of July 18, from one to two minutes each. Furthermore, only in the late afternoon do conditions seem to favor their formation.

2. The rapidly rising column of saturated air in a cumulus cloud *apparently* elevated the superincumbent layers. The time interval between the appearance of the scarf and the entrance of the cumulus cloud into it gives some measure of the distance to which this raising is effective. And the time the cumulus top takes in going through the cap gives a rough measure of the thickness of the humid layer. The apparent rising motion of the cumulus towers indicates an ascending current, say, of 7 meters per second (a value which the writer once determined instrumentally at Blue Hill Observatory). With the average interval of 30 seconds from the time of appearance of the scarf to the entry of the cloud, the distance may be 200 meters. The thickness of the scarf is less than 400 meters, probably less than half this, for the scarf is raised with the cloud, and also the cloud comes through before it becomes visible below. The diameter of the scarf may easily be 1 kilometer, yet it formed almost instantly.

3. The top of the cumulus cloud actually does not move forward as fast as the flat clouds at the same level. This is to be seen when the false cirrus advances 50 or 100 kilometers before the oncoming thunderstorm; but rarely do we see a flat cloud overtake and surround the cumulus dome. Such was the case July 13; the great cumulus cloud, like a mountain, interrupts the free flow of the wind. Perhaps these scarf clouds like the helm clouds of mountains are formed by the winds rising to pass over the dome, rather than by the up-push of the rising cloud column.³

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SOME FIELD EXPERIMENTS ON EVAPORATION FROM SNOW SURFACES.

By F. S. BAKER, Forest Examiner.

[Utah Experiment Station, Ephraim, Utah, June 25, 1917.]

In the irrigated section of the Great Basin of the western United States, one of the chief factors affecting crop production is the amount of snowfall in the adjacent mountains, as melting snows give rise to most of the irrigation water. So important are these snows that annual surveys are made on some of the more important watersheds in order to forecast, in a general way, the amount of run-off likely to be available. In other places windbreaks have been built in attempts to divert the drifting snow to certain watersheds. The amount of snow that will be effective in yielding water for use in the valleys is therefore of considerable importance throughout this entire region. In making snow surveys it has, of course, been recognized that much of the snow water is lost to surface run-off by evaporation and by percolation into the soil, but the magnitude of these losses has never been determined.

At the Utah Forest Experiment Station, located on the Manti National Forest in the mountains of central Utah, an experiment is under way dealing with the effects of grazing on the erosion of the high mountain ranges. Two small drainage areas have been selected and equipped with sediment basins and weirs at their lower ends to determine the run-off and amounts of sediment that come from these areas during rains and seasons of melting snow. One area is to be grazed while the other is to be revegetated. One of the effects of revegetation will probably be to increase the percolation of snow water into the ground. This loss can not be directly determined, however, but as the amount of water on the areas in the form of snow is determined by surveys and the amount of run-off is obtained from weir readings, the water lost

³ See *Max Reinganum in Meteorol. Ztschr.*, Mai 1912, 29:242-3.